MINISTRY OF LABOUR

Power Press Toolsetting and Tool Design

Sixth Report of the Joint Standing Committee on Safety in the Use of Power Presses

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Contents

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*The particulars given are those applying at the time of appointment.
†These members joined the Sub-committee after completion of Part I to augment it in its consideration of tool design for Part II.
‡Mr. Mawson, later H.M. Deputy Senior Engineering Inspector of Factories and at the time of his death H.M. Superintending Inspector of Factories and Chairman of the Joint Standing Committee, died 7th April 1966.

To: The Right Hon. R. J. GUNTER, M.P.
Minister of Labour

Sir,

We have the honour to present our Sixth Report of Proceedings which deals with the subjects of power press toolsetting and power press tool design.

In our Fifth Report we referred to the fact that a Sub-committee was currently engaged in preparing reports and recommendations for toolsetting and tool design. These two subjects have special parts to play in safe working at power presses and our experience suggests that it is highly important that all firms having power presses in their factories and all firms engaged in the manufacture of press tools should have a clear grasp of these matters.

The preparation of a power press for production involves the placing and adjustment of the tools and an appraisal of the correctness of the setting by the taking of trial pressings. About 10% of the total number of power press tool accidents each year are sustained by persons, usually of the skilled toolsetter category, while engaged in these processes. We requested our Technical Sub-committee to examine toolsetting procedures with a view to formulating a statement of the problems and making recommendations as to the best practical ways in which these procedures could be carried out in the safest manner. Part I of this Report contains the Sub-committee's report and recommendations, which we entirely support.

We would draw your particular attention to para. 8(*a*) of the Report. This refers to movement of the crankshaft by power in a specially controlled way generally referred to as 'inching'. On presses with friction clutches, this is usually achieved by means of an electrical control which, when operated and as long as it is operated, causes continuous movement of the crankshaft. The amount of movement lies therefore in the hands of the person operating the 'inch' control. Movement limiting devices have been developed which are designed to ensure that for each operation of the 'inch' control only a small, pre-determined amount of crankshaft movement can take place. These devices have merit as they should prevent inadvertent excessive movement, which might lead to danger, and are worthy of wider development and adoption.

It would be appropriate at this point to say that Part I is particularly relevant at this time when the Power Presses Regulations 1965 have been made, containing, as they do, requirements as to the competency in relation to safety of those who are to be allowed to perform toolsetting and allied procedures. We hope, therefore, that every available opportunity will be taken to publicise these recommendations and that they will be used in connection with schemes of training which are arranged as a result of the requirements of the Regulations.

A potent reason for the continuance of power press accidents is the fact that in a large number of cases operators have to place their hands within the trapping area for the purposes of production. This they may have to do thousands of times per day and it is clear that a situation of this kind calls for an extremely high standard of reliability of presses and safeguards if the coincidence of press motion and the interposition of hands within the trapping area is to be avoided. It is, therefore, very profitable to make every effort to design press tools in such a way as to avoid any need for the operator's fingers to enter the trapping area. Much can be achieved in this connection by tool design. The second task of our Sub-committee was therefore to study and make recommendations on safe tool design and its report forms Part II of this Report. We

are unanimous in our view that these recommendations are most important and deserve maximum publicity, especially amongst those concerned with press work production and with the design of press tools. It sets out a number of important principles and we are satisfied that observance of these should not in any way adversely affect production. In fact we feel that the reverse is the case, for no operator at a power press can be otherwise than instinctively anxious when he appreciates the consequence of the closure of press tools upon his fingers. The fact that his hands are no longer required to enter the danger area must give him the confidence to approach his duties with greater effectiveness.

Neither the Sub-committee nor ourselves would claim great originality in the proposals which are made in Part II. As long ago as 1945 when the original Committee, appointed by the Chief Inspector of Factories, made its Report (the Main Report) the importance of safe tool design was stressed. We nevertheless consider that the Report now submitted contains much valuable information which is well illustrated and would like to suggest that if these matters are to be fully appreciated and acted upon, the mode of publication of our recommendations should be particularly studied from the point of view of putting them into the hands of those concerned in a popular and attractive manner.

The Committee are anxious to take this opportunity of paying tribute to the work of the late Mr. R. K. Mawson who, from April 1964 until his death on 7th April 1966 was Chairman of this Committee. Mr. Mawson served the Committee from its inception, first as both Secretary and Member (1946–62), then as Member, and finally, after its reconstitution in 1964, as Chairman. He was Secretary of the Technical Sub-committee whose Report we now present. Mr. Mawson brought to bear, throughout, great technical skill and a most extensive knowledge of power presses and their problems. His contribution to the cause of power press safety was immense and he leaves a gap which cannot easily be filled.

We have the honour to be, Sir,
Your obedient servants,

(Signed) E. W. HODGSON (*Chairman*)
F. C. ARNAUD
W. H. L. BROGDEN
H. D. CHALLEN
A. GOW
E. G. HANDS
L. R. KEALEY
J. R. MOORE
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J. D. UDAL
J. HIRD (*Secretary*)

PART I: SAFETY IN TOOLMAKING AND TOOLSETTING PROCEDURES

1. The Sub-committee has considered current procedures both by visits to factories and by discussion. Recommendations which it is felt will contribute to a reduction in the risks to which toolmakers and toolsetters are commonly exposed are made in paragraphs 4 to 10.

2. At the time tbe Sub-committee commenced its discussion it was understood that from a legal standpoint, the mere fact that toolmaking, toolsetting, tool try-out or tool adjusting procedures were in progress afforded no relief from the requirements to provide and keep in position fencing for dangerous parts while they were in motion or use. Tbe fact that a ram of a press might be in movement by hand manipulation or by a power 'incbing' method was not thought to be distinguishable in law from the normal method of operation on production. If there was danger, fencing was required. Members do not consider it to be their duty to comment further on this aspect. The Sub-committee bas made recommendations which it regards as contributing to safety and which are practicable to follow.

3. These considerations have necessarily led to a review of current forms of guarding – particularly interlocking and automatic guards because these guards, while primarily designed for production purposes, will, in the absence of otber guards, be those to be used during setting and other preliminary procedures. There are grounds for believing that a trend in tbe direction of designing interlocking guards so that they are swung out of position to one side rather than upwards has advantages for tbe toolsetter. During the try-out* period there will be frequent removal and replacement of guards and the new trend may reduce fatigue.

*Tool try-out includes the taking of trial pressings.

Recommendations

4. These recommendations are intended to be applicable to all cases where power presses are used, either in connection with the manufacture or repair of press tools or during the processes of setting up or trying-out *of tools.

General

5. The press ram should never be moved by a power method which would result in a complete stroke unless the guard is in position and the person in charge of the operations is satisfied tbat the tools are correctly placed and adjusted so that a complete stroke can be made without danger. In all other instances, tbe ram should be moved by a hand metbod or by a power metbod which will permit the operator to stop tbe ram movement at any point in the stroke. It is considered that a press baving a tonnage rating of 100 tons or less can be pulled round by hand. It is recognised that this may be a laborious procedure but in the present state of knowledge it is thougbt to be the safest method.

Note: Many presses in excess of this rating could be pulled round by hand.

Presses used exclusively for toolmaking, tool repair and tool try-out*

6. Presses used exclusively for toolmaking, tool repair work and tool try-out should be provided with a guard or guards, including side and back guards as necessary, for effectively enclosing any trapping areas when moved under power. Guards can be conveniently of the interlocking type embodying a vertical sliding screen together with appropriate side guards as necessary (Figs. 1 and 2). The side guards can also be combined with tbe front screen to move as one, thus giving the tool maker ready access for adjustment purposes. In the case of presses and tools which are appropriate for guarding by means of 'push-away' guards, a readily detachable bar or bars may be substituted for tbe rising screen during die repairing and setting procedures (Figs. 3, 4 and 5).

*Tool try-out includes the taking of trial pressings.

Toolsetting procedure on presses which can be pulled round by hand

7. (*a*) Stop the flywheel in all cases. This can be done in all those instances where the press is independently driven by its own motor and also where a fast and loose pulley system is used on belt driven presses.
   (*b*) If the press is normally used with an interlocking type of guard, any interlocking device which controls the engagement of the clutch should only be displaced from the locking position by hand and only for such time and to such extent as may be necessary to permit the clutch to be engaged.
   (*c*) Bring the ram down to the bottom of the stroke.
   (*d*) Adjust the ram so that there is just sufficient room for the shut height of the tools to enter the space between the underside of the tool holder and the table.
   (*e*) Slide the die assembly on to the bed.
   (*f*) Adjust the ram, attach the tools and make necessary adjustments.
   (*g*) After coupling up the tools and before the ram is run to the top of the stroke, the guard should be connected up and from this point onwards a guard should always be used.

Note: Many existing tools and presses will not permit this procedure to be followed. As far as possible new tools should be designed with the objects of permitting the procedure outlined in the above to be followed and existing tools should be modified as opportunity presents itself. Where it is not possible to do this, the following procedure may be adopted:

(*a*) Stop the flywheel in all cases. This can be done in all those instances where the press is independently driven by its own motor and also where a fast and loose pulley system is used on belt driven presses.
(*b*) If the press is normally used with an interlocking type of guard, any interlocking device which controls the engagement of the clutch should only be displaced from the locking position by hand and only for such time and to such extent as may be necessary to permit the clutch to be engaged.
(*c*) Bring the ram down to the bottom of the stroke.
(*d*) Using the ram adjustment, appropriately load the punch into the ram.
(*e*) Again using the ram adjustment, arrange the clearance between the punch face and the bolster so as to permit entry of the die.
(*f*) Slide the die assembly on to the bed.
(*g*) Using the ram adjustment, enter the punch and die and bolt down die to bolster.
(*h*) Continue the ram adjustment, adjust tool and die relationship to 'bottom' as necessary.
(*j*) After coupling up the tools and before the ram is run to the top of the stroke the guard should be connected up and from this point the guard should always be used.

Toolsetting procedure on presses which cannot be pulled round by hand

8. (*a*) Presses of over 100 tons rating will include both positive and friction clutch operated types. In so far as any necessity arises for moving the crankshaft on a positive clutch operated press under 'inching' conditions, this will in general have to be done by 'inching' the motor with the clutch engaged.

   In the case of friction clutch operated presses, the clutch control systems may be mechanical, pneumatic or electrical. In any event the movement of the ram can be controlled with more or less precision by hand manipulation of the clutch control system.
   (*b*) Until the tools have been mounted in the press and are judged ready for a full power stroke, the ram should only be moved by a method which will ensure cessation of movement at any point in the stroke on release of the operator's control.

(*c*) Before the tools are placed on the bed of the press, the shut height should be adjusted to admit the tools.

(*d*) After coupling up the tools and before the ram is run to top of the stoke the guard should be connected up and, from this point onwards, a guard should always be used.

Note: When removing tools the press should be at the bottom of the stroke and the flywheel stationary before the guard is removed.

Design of interlocking guards

9. The conventional interlocking guard is swung upwards on its suspension shaft when it is required to be put out of the normal position. It is held in this position by some form of hook. It is a frequent comment of toolsetters that considerable physical effort is required to raise the larger guards and when they are in this position they constitute a potential hazard if the supporting hook should break. Interlocking guards should be so designed that ready access to the slide adjusting screw can be obtained without swinging the guard out of its normal working position. Recent developments have taken place in the design of these guards whereby they are mounted on vertical hinge pillars at the side of the press. This appears to be a promising development and one which would make the work of the toolsetter easier and therefore would tend to diminish the chance of guards not being replaced when they should be (Fig. 6).

10. When an interlocking guard with mechanical interlocking is swung out of the normal working position and it is required to move the crankshaft, the extractor interlock controlled by the guard may have to be moved in order to allow barring over to take place. It is recommended that any hook or other device for holding the extractor interlock clear of the extractor should be a type which will compel it to be released as a condition of moving the guard to the working position.

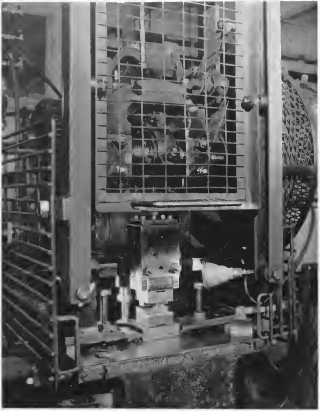


FIG. 1. A vertical sliding screen interlock guard on a press with a positive clutch (guard open).

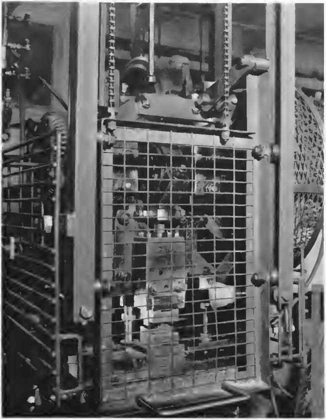


Fig. 2. A vertical sliding screen interlock guard on a press with a positive clutch (guard closed).

Fig. 3. Automatic guard with special removable bar. (Guard in position and a jack between the tools).

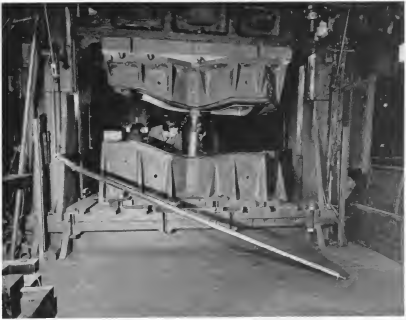


FIG. 4. Guard disconnected for access to tools with jack in position.

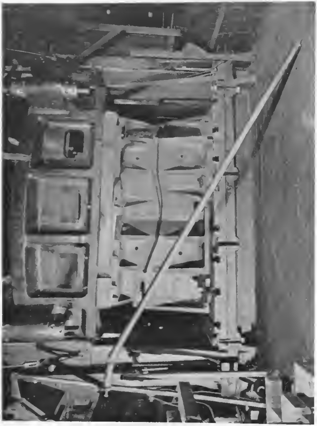


Fig. 5. Guard disconnected and tools closed.

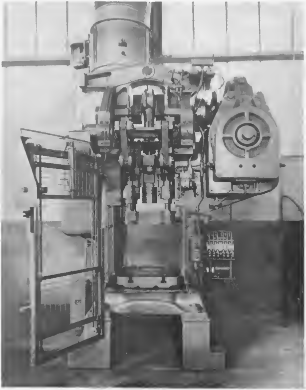


FIG. 6. An interlocking guard with side-swinging frame showing frame swung to one side.

11. Following the completion of its report on toolsetting procedure (Part I of this Report), the Sub-committee turned to a consideration of its second task, namely to make recommendations in regard to tool design which would have as their object improved safe working conditions for operators. Members felt that in order to give adequate consideration to this subject it would be of value to strengthen the Sub-committee by inviting some persons who were actively engaged in tool design and manufacture to join. It was fortunate in securing the services of Messrs. K. Price, G. J. Sprayson and G. Wright. Since this increase in membership, 12 meetings have been held. The Sub-committee now has pleasure in presenting Part II of the Report.

12. At the outset the Sub-committee had before it Appendix III of the Main Report of 1945 which was made by the Committee set up by the then H.M. Chief Inspector of Factories to advise him on matters connected with the safe working of power presses. Appendix III dealt with the use of static fixed guards and described aspects of tool design the adoption of which would facilitate the use of this type of guard. The Sub-committee is aware that, for a number of important reasons, it is found necessary to employ other types of guards such as interlocking and automatic guards. While a discussion of the relative merits of the different forms of guard is outside the terms of reference, members would agree that any system which prevents the entry of the fingers of the operator into trapping spaces is a most important contribution to the general safety situation. It is thought that regardless of the actual type of guard employed, all concerned with the running of press operating departments should have firmly in their minds the importance and desirability of eliminating or at least reducing to a minimum the need for operators to reach into trapping zones. The Sub-committee would also like to emphasize the importance of putting tools into presses which are appropriate both as respects capacity and safety of working.

13. It is known however that the provision of feeding and extracting devices for safety, and not for assisting the productive rate, may be difficult to justify on a purely economic basis for they will generally involve additional costs which some users may be unwilling to incur. On the other hand, it has been put to the Sub-committee that there are frequently simple feeding and ejecting devices which, in themselves, will tend to increase production. Members think that an operator, for example, who has to spend time manoeuvring workpieces in or out of a die will be unlikely to operate at the optimum rate, for he may well be conscious of the fact that his fingers are in a place of possible danger, a feeling only partly allayed by the presence of a guard.

14. The Sub-committee felt that it should first consider questions of component ejection. After a component has been made, it should be removed from the working area of the tools with the minimum of delay, and without the need for handling within the trapping area. Ejection devices for this purpose, usually automatic in character, are regarded as a normal feature which should be provided as a matter of course. For effective results, ejection should comprise not only the means by which the component is released from the die and the punch but also the means for transporting the component away from the die area.* Included under this consideration there is also the question of scrap removal. Unwieldy scrap is often hampering to an operator and may positively introduce a hazard. The Sub-committee therefore considers that proper means should be made for the disposal of the scrap. In this connection, the members would emphasize the value of scrap cutters, either as an integral part of tools or as an adjunct. Scrap disposal is also important in relation to piercings (Fig. 7). It is not unknown for an accumulation of piercings to jam tools and even result in fracture of parts of a press due to the resulting overload. In paragraphs 22 to 29 the Sub-committee states its recommendations with regard to component ejection. No apology is made for stating what might be considered to be elementary matters.

*Including, for example, discharge chutes and conveyors (Figs. 7 and 8).

The fact is that far too little attention is given in practice to the observance of these straightforward points. The Sub-committee would like to make a special comment on the vital necessity to provide effective guards to prevent access to the blades of scrap cutters. Members have been informed of serious accidents due to neglect to observe such a precaution. Arrangements can be made for the interlocking of guards so that, except when these are in tbe guarding position, movement of the cutters cannot take place (Figs. 9 and 10).

15. The Sub-committee then turned its attention to component feeding. While it is technically possible in almost every case to provide an arrangement whereby a component can be fed from outside the tools into the working area, members came immediately against the problem of cost. There is no doubt that to provide feeding devices will involve additional expense in tool design and possibly also in machinery equipment. Many users will only see a justification for such additional expenditure if there are comparable gains in production or reductions in operating costs. It is known tbat under conditions of automated production, feeding devices must necessarily be provided, but it is in the field of less intensive production where we look for improvements in the way of feeding arrangements. The Sub-committee believes moreover tbat some gains in production can be achieved but would stress tbat the important matter for consideration is safety of operatives.

16. Another approacb to minimising the hazard is by reducing the number of bandlings required to produce a given article. It is well known tbat tools can be designed wbicb will embody a series of operations which might otherwise be undertaken as single stages, each stage requiring a press stroke. A diagram illustrating the combination of stages is included (Fig. 11). It has been pointed out however that the advantages are not on one side. Single stage press work involves very simple tools which are readily repaired or altered. It is otherwise with an expensive follow-on tool which can in general only fulfil one purpose and is not susceptible to alteration for another type of operation. Nevertheless, it is thought that from a safety point of view it is an impressive fact that one press stroke can be used to produce a finisbed article wbere four strokes were required on single stage working. This automatically reduces the number of bazardous approaches to tools.

17. Much work has been done in recent years on the production of transfer mechanisms, some of which can be introduced into an existing type of press. These mechanisms facilitate the handling of components right through a complete stage of manufacture without tbe necessity for the entry of hands or fingers to danger areas. The Sub-committee commends such arrangements as having a considerable benefit for safety.

18. Paragraphs 30 to 34 summarise the Sub-committee's recommendations with regard to component feeding and a number of illustrations of methods which are in use are included. Observations on the use of strip or stock fed tools are made in the Appendix to the Report.

19. A number of items of a miscellaneous cbaracter affecting safe tool design have been given consideration. Members understand tbat pressure clamping of tools by hydraulic means is a technique likely to be increasingly adopted, instead of the conventional system (Figs. 12 and 13) of clamping with clamps and bolts. It is thought that a system of this kind should be very carefully designed from the point of view of safety and it has been suggested by members that where a bydraulic system is used for inserting wedges or clamps these ought to be self-sustaining once they are in tbe holding position. That is to say, tbe Sub-committee does not favour employment of the hydraulic pressure actually to sustain or hold the tools in position. Failure of the pressure system could result in the fall of a punch, or displacement of the tools, unless other provisions such as tenons or dovetails are provided. Members have also heard references to accidents due

to loose pads or knock-outs in tools becoming detached. Observation of the circumstances has suggested that there is often a lack of robustness in the detailed arrangements for retaining these pads. Many dies employ cams for side action. It is important that care should be taken to provide adequate local guarding for cams and also that there should be arrangements to be sure that in the event of bolt fracture there will be no danger from flying parts. It is thought that where possible a double action cam arrangement without springs present advantages.

20. Care should be taken to see that all sharp edges and corners are removed from exterior and non-working parts of tools. Where automatic guards are used there should be no projections or obstructions that could hinder the free removal of a person's hand from the vicinity of the tools. The Sub-committee would also strongly recommend the standardisation of heights of tool clamping faces, so as to facilitate the use of standard clamps (Fig. 12 and see also item 4 of General Observations below Fig. 13), instead of the somewhat haphazard and hazardous arrangements often seen. In some circumstances it is possible to screw a bolt into a larger diameter tapped hole and obtain a marginal degree of retention. Such application can fail under working conditions and it is desirable to standardise bolt diameters with sufficient difference to obviate this happening. In order to reduce wear to tapped threads it is generally advisable to secure tools to the ram by bolts or set-screws screwed into the tools rather than into the ram (Fig. 13).

21. The Sub-committee would like in conclusion to urge an acceptance by those concerned with the provision of press tools that safety must always be an important consideration in design and that suitable directives should be given to all concerned with the actual working out of these designs. This means for instance that tool designers and draughtsmen should be encouraged to see that when they design tools, provision is made for ejection and feeding of a component without insertion of the hand or finger of the operator. Members are convinced that with greater use of these facilities, which are referred to and illustrated in some detail in this Part of the Report, a notable contribution can be made to the reduction of accidents.

Recommendations

Component ejection

22. It is put forward as a principle that no tool should be manufactured without the provision of effective arrangements for the release of the component from all surfaces, pins or recesses in such a way that it can be freely discharged from the pressing area, either by means incorporated in the tool or by other arrangements provided on the press. The objective behind this proposal is that an operator should not be required to be concerned with the direct manual removal of components from within the trapping area. It is known as a matter of experience that a high proportion of accidents occur when operators are removing components and are overtaken by a press stroke such as that which occurs during repeating.

23. The provision of arrangements to meet para. 22 will usually consist of the following:

(*a*) an ejector, or ejectors in the die,

(*b*) a push off arrangement on the punch,

(*c*) a stripper, and

(*d*) some form of pusher, flicker, pneumatic or mechanical device to remove the component from the die area. (Figs. 14, 15, 16, 17 and 32. See also Figs. 7 and 8 for chutes and conveyors and Figs. 47, 48 and 49 for unloaders.)

Attention is drawn to the possibility of using automatic devices to detect failure of component ejection. Such devices should immediately prevent further strokes until the component is cleared.

24. *Bottom ejection.* The aim will be so to release the component that it is effectively clear of any part of the die which would interfere with the free removal of the component by, for example, horizontal discharge. There are numerous techniques available. Examples are springs, rubber rings and pads, air cushions, pneumatic and mechanical systems (Figs. 14, 15, 16, 18 and 20). Particular care is necessary to see that bolts which are stressed by compression of rubber pads are not loaded to such an extent that fatigue failure may ensue.

25. *Top ejection.* Most presses provide means for knock-out derived from the ram movement If this is not available other means should be adopted such as the use of compressed air (Fig. 19). It is well known that the suction effect between components and tool surfaces can interfere with release. Grooving of punch surfaces can, for example, minimise sticking of components to punch and die surfaces in planishing operations. This is also important in the case of compound blanking dies, and special attention must be given to the provision of means for releasing components adhering to the ejector. Suitably arranged spring-loaded pins would achieve this.

The correct setting of knock-out bars is highly important; oversetting can result in damage to the press, and can lead to a hazard by reverse movement of the crankshaft.

26. *Punch stripping.* Effective provision for stripping components from the punch must be provided (Figs. 17 and 18). In the case of drawn shells specialised arrangements are often necessary, including adequate air venting.

27. *Discharge arrangements from blanking tools.* Designers should see that blanking tools with open bottom dies should be arranged to permit automatic gravity discharge of the components through the press bed (and bolster).

Where press bed openings are not large enough to permit this, consideration can be given to setting up the die above the bed leaving enough clearance to allow the blank to fall onto the bed and be discharged therefrom. On inclined presses, gravity will assist this discharge through to back of the press. This will raise questions of die strength in view of the lack of support for the die which would be involved.

On 'reversed' and combination blanking tools, the component or the piercings are returned in the upper die and normally top ejected. The top ejected parts can then be removed by use of a catch tray which is timed to move between the dies during the upper part of the press stroke (Fig. 49).

28. *Scrap disposal.* In the case of cutting tools such as those used for flash removal, means should be provided for release of scrap e.g. by suitable cutting edges, reducing it to a size suitable for disposal. Means should further be provided for the discharge of scrap from the area around and on the die. This involves careful consideration of suitably sized openings through which the scrap can be discharged. Alternatively arrangements for the blowing away of scrap should be provided. The actual air blowing arrangements should be the concern of the tool designer; moreover be should design the tools so that there are no irregular shapes or recesses which might interfere with the free disposal of scrap. Areas at the back of the die should be kept clear. When providing means for scrap disposal, great care must be taken to avoid weakening of the holster.

29. *Disposal of piercings.* Piercings have been known to accumulate under dies using air cushions and have been responsible for the development of resistance to the ram movement with consequent fracturing of connecting rods or of crankshafts. Designers should see that piercings cannot accumulate in places of this nature. Wherever possible an arrangement should be used with side deflectors on cushions which can be arranged to dispose of piercings effectively (Fig. 20).

Component feeding

30. Wherever possible components should be fed by methods other than those which involve placing the fingers in the trapping zone. It is recognized that adoption of such methods may increase tool costs but it is known that improved output can often be achieved with the use of non-manual methods of feeding. The gain in safety however is undeniable.

31. *Strip or stock fed tools.* Efficient stops of the trigger, automatic or notch type should be provided. (Examples of trigger stops: Figs. 21 and 22. Guard not shown in Fig. 21.) Fixed stops (Fig. 23), though simple and cheaper, can interfere with passage of material and they are not favoured. Wherever possible tools should be of the enclosed type so arranged as to prevent access of fingertips to any area of trapping (Fig. 24). The width of stock should be sufficient to ensure that punches cannot cut through the edges of the stock (Fig. 25). Spring-loaded guides and pilots for correctly locating stock during feeding are essential in some cases. (Fig. 26 shows the effects of excessive guide clearance. Fig. 27 gives examples of adjustable guides and Fig. 28 of spring-loaded guides.) In the Appendix to this Report there are observations on the use of strip and stock fed tools.

The correct stroke of the press should be clearly marked on the tools.

32. *Hand feed production.* The following are examples of techniques which avoid the insertion of fingers into a trapping area, and which do not require power operation:

(*a*) sliding dies,

(*b*) gravity (and other) feed chutes and magazines (Figs. 29, 30* and 31),

(*c*) dial feeds,

(*d*) sliding nest feeds (Figs. 32, 33 and 34), and

(*e*) hand feed appliances e.g. tongs, grippers, magnetic and suction (Fig. 35).

33. *Power feed operations.* Where production demands it, a power feed system presents obvious advantages. There will necessarily be complete avoidance of placing the fingers in a danger area for feeding purposes, and moreover, because the press will normally be run on a continuous basis, hazards arising from clutch defects are much less likely. The principal types of power feed device are:

(*a*) roll feeds of strip or coil material (Figs. 36, 37 and 38),

(*b*) bow feeds (Fig. 39),

(*c*) gripper feeds in which the stock-sheet is traversed through the die area (Fig. 40), sometimes with automatic removal,

(*d*) dial feeds (Figs. 41 and 42),

(*e*) slide feeds (Figs. 30 and 43),

(*f*) transfer mechanisms (Figs. 44, 45 and 46),

(*g*) mechanical loaders and unloaders (Figs. 47, 48 and 49),

(*h*) inter-press transfers and

(*j*) suction feeds, magnetic feeds and mechanical feeds (Figs. 50 and 51).

Note: Proper attention must be given to the guarding of the dangerous parts of these mechanisms.

34. *Note on precautions with certain types of feed.* Where a sliding die or feed is of a kind which would foul the line of descent of the punch except when properly located, it is a necessity to provide an interlock incorporated in the feed or the tool to ensure that the clutch may not be engaged except when the tool and feed is in correct location.

*Fig. 30 shows a gravity magazine but with power-operated feed.

FIG. 7. Separation of components from piercings. The piercings pass down the pipe which is shown in the top left hand corner of the photograph.

FIG. 8. Discharge chute and conveyor for removal of work from operating area of the tools.

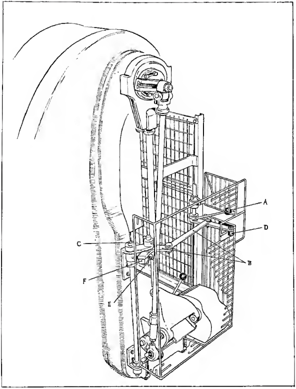


FIG. 9.

Interlocked guard for a scrap cutter. Positive key clutch type press. Movement of the guard from the safe position renders the press inoperative. The side guard is hinged at the rear of the machine at point 'C' and the interlock is connected through the link mechanism 'B' to the main interlock on the front screen. The movement of lever 'A' towards the centre of the machine interlocks the clutch mechanism and releases side guard interlocks allowing the guards to be hinged open. This can be achieved only when Roller 'D' is clear of the side guard at the front and the Cam 'E' is released by interlock 'F'.

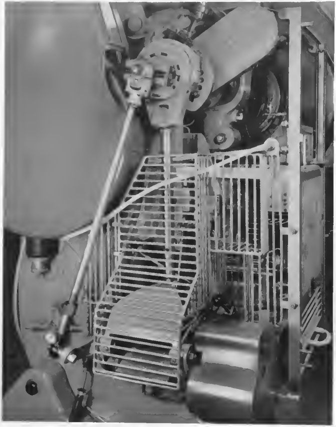


FIG. 10.
Interlocked guard for scrap cutter. Friction clutch type press. Movement of the guard from the safe position must render the press inoperative. In the case of the guard shown in the illustration, this is achieved by disconnection of the air line to the press clutch.

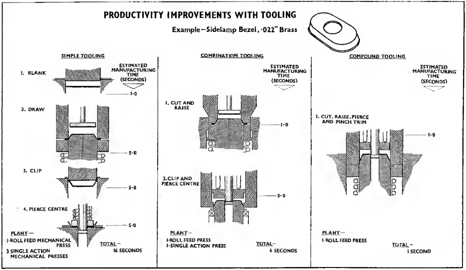
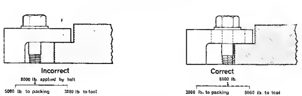


Fig. 11.

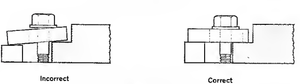
Combination of operations showing how four individual operations can be combined, first into two sets of combination tools and finally into one compound tool, so reducing the number of feeding operations.

PRESS TOOL CLAMPING PRACTICE (BOTTOM TOOL)

(*a*) Ensure that adequate clamping area is provided on the tool.



(*b*) Ensure that maximum pressure is exerted in securing tool.

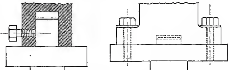


(*c*) Ensure that if packing is used it is the same height as tool face.

(*d*) Always use substantial clamping plates.

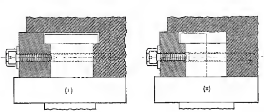
FIG. 12.

PRESS TOOL CLAMPING PRACTICE
(TOP TOOL)



(*a*) Never rely on side pressure alone on a plain shank.

(*b*) Where possible use bolts to secure top tool.



(*c*) If bolts or clamps cannot be used, protection must be provided by a collar or half collar.

Many presses which have no recess provided can easily be modified by machining recess in the loose box and using a half collar on the tool. (Illustration (II)).

FIG. 13.

GENERAL OBSERVATIONS APPLICABLE TO CLAMPING OF TOP OR BOTTOM TOOLS

1. Ensure that the corners of both nuts and bolt heads are in good condition, and always use the correct spanner. Failure to observe these points can result in accident hazards from:—
   (*a*) loose tools *or*
   (*b*) slipping spanners.

2. Avoid the use of bent bolts, distorted threads. Even with high spanner torque, the tool may not be clamped adequately.

3. Always use washer under head of bolt.

4. Standardisation, where possible, of clamping height in tool design will enable a standard heel clamp to be used – eliminating loose packing hazards.

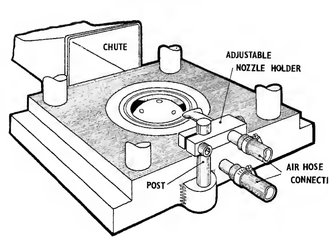


FIG. 14.
The application of air blast to press tools for elevation and discharge of the component from the working area. The post is provided as part of the die equipment so as to avoid temporary rigs by the production department.

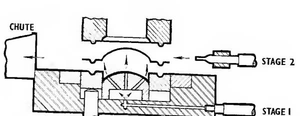


FIG. 15.
Section of the combination tool illustrated in FIG. 14 showing the two stages of air ejection.

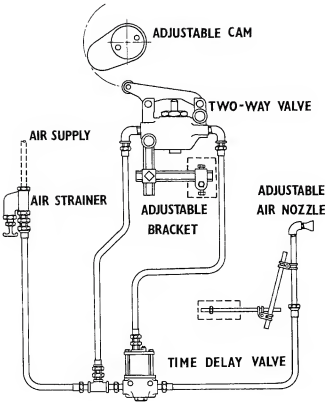


FIG. 16. A typical diagram of connections for operating air blast.

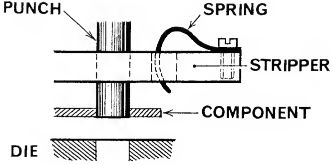


FIG. 17.
Spring operated discharge device. As the punch ascends the component is stripped off the punch and the spring flicks the component away from the die area.

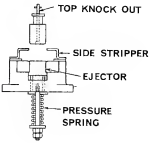


FIG. 18.
Diagram of a typical bending tool showing arrangements for release of component from the tool members.

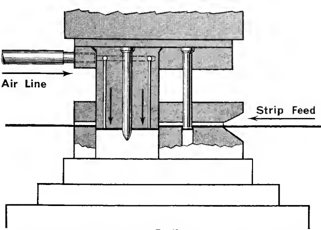


Fig. 19.
Application of air jet to prevent blank from sticking to punch. Can also be used on piercing as alternative to a spring plunger.

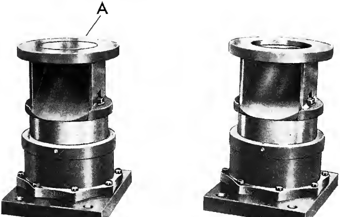
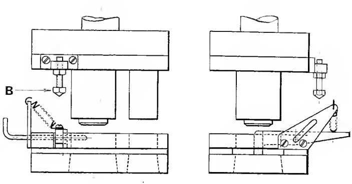
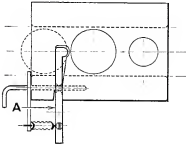


Fig. 20.
A die cushion. When the pressure pad 'A' is removed as shown in the right hand illustration, pressings from a cutting die can be discharged.





The trigger stop is operated by an adjustable hammer 'B' (fitted on the punch holder) striking the pivotted trigger 'A' fitted on the die stripper. The trigger is actuated by a tension spring pulling upwards and sideways. When the trigger is pushed down by the hammer the head of the stop is lifted out of the stock and moves sideways to drop on to the web between the blank holes in the stock, so, when the stock is fed forward the head drops into the next blank hole in the stock.

Fig. 21.

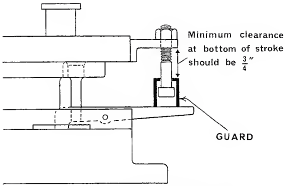


FIG. 22. Guard for trigger stop actuating pin, short stroke.

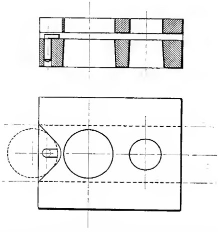


FIG. 23. Fixed stop pin fitted into the die. The stock is fed over the stop until it drops into the blank hole and is pushed against the stop.

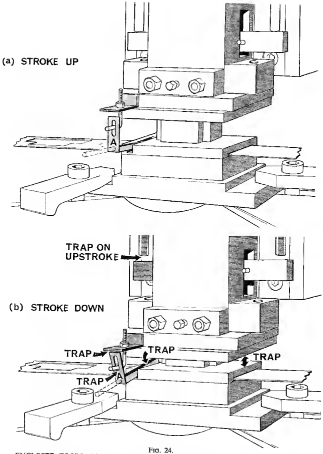
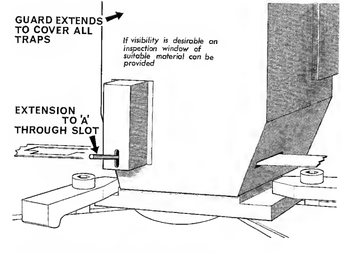


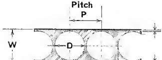
FIG. 24.

ENCLOSED TOOLS. (*a*) and (*b*) show the traps that can occur even when enclosed tools are used, (*c*) shows a guard that deals with these traps. This guard enables operator to manipulate strip close to the tools thereby eliminating excessive scrap.



(c) FIXED GUARD ENCLOSING TRAPS

FIG. 24.



Material thickness = t

Minimum webbing allowance $w = 1{\cdot}25\,t$

Pitch $P = D + w = D + 1{\cdot}25\,t$

Strip width $W = D + 2w = D + 2{\cdot}5\,t$

FIG. 25.

RECOMMENDED WEBBING ALLOWANCES MATERIAL RANGE. 0·015 in. to 0·080 in. THICK. STEEL, COPPER, BRASS, ALUMINIUM AND METALS GENERALLY.

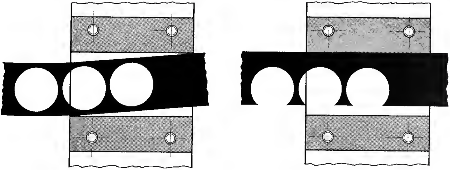
Example

2 in. DIA. BLANK, MATERIAL THICKNESS =0·060 in.
MIN. WEBBING ALLOWANCE 'w'=1·25 × 0·060 in. = 0·075 in.
PITCH 'P' = 2+0·075 in. = 2·075 in.
STRIP WIDTH. 'W' = 2+0·150 in. = 2·150 in.

Note

WHEN THINNER MATERIALS ARE USED AND THE CALCULATED ALLOWANCE IS BELOW 0·046 in., THE FORMULA DOES NOT APPLY AND A MINIMUM WEBBING THICKNESS OF 0·046 in. IS SUBSTITUTED.

EFFECTS OF EXCESSIVE GUIDE CLEARANCE

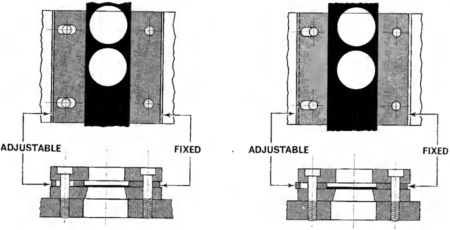


(*a*) Distorted webbing resulting in difficult feeding

FIG. 26.

(*b*) Unbalanced webbing tool produces incomplete components

EXAMPLES OF ADJUSTABLE GUIDES

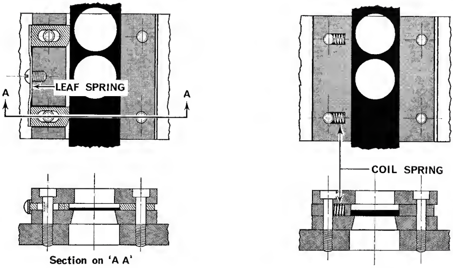


(*a*) Normal webbing allowance

Fig. 27.

(*b*) Excess allowance

EXAMPLES OF SPRING LOADED GUIDES



(*a*) To suit thin material

FIG. 28.

(*b*) To suit thicker material

Fig. 29. Fixed guard with feed slide and chute for 'posting' component to drawing operation.

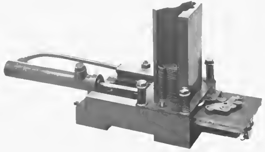


FIG. 30 Air cylinder magazine feed.

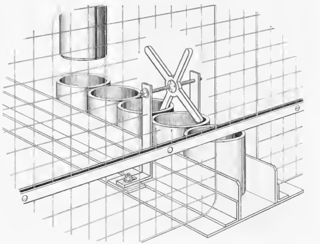


FIG 31. The feed chute to a drawing tool. The guard is shown cut away to illustrate the simple method of ensuring that cup shaped components are not fed in upside down; this also prevents a hand from reaching the danger area when no components are in the chute.

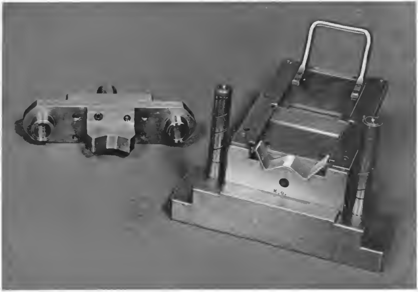


Fig. 32. Sliding push feed for a bending operation. The component is pushed off the die by the leading edge of the incoming blank.

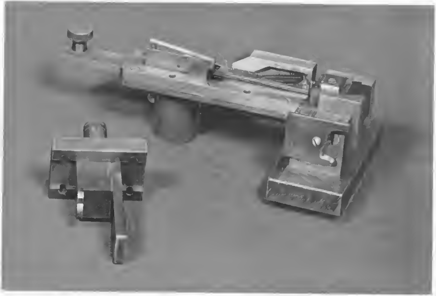


FIG. 33. Slide feed carrier which is designed to lift the component and place it over locating pins.

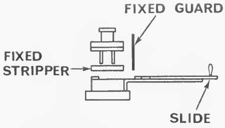


FIG. 34. A slide feed enabling components to be fed to the working area beneath a fixed guard. Design of the slide must be such that it is impossible for the punches to strike the slide.

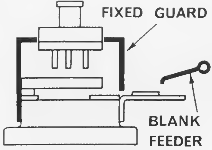


FIG. 35. Simple plate feed using hook type blank feeder.

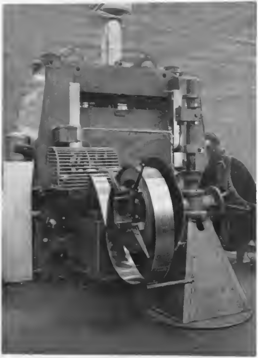


Fig. 36. Coil feed to transfer press.

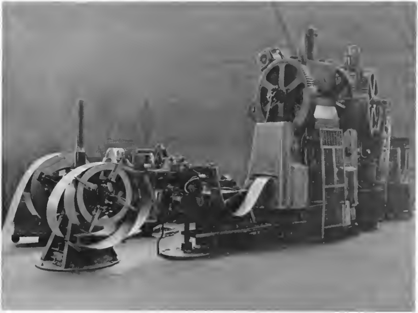


FIG. 37. Coil holder with independent straightening roll feeding roll feed press.

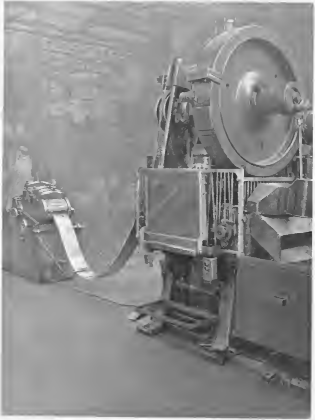


FIG. 38. Combined coil cradle and straightening rolls feeding roll feed press.

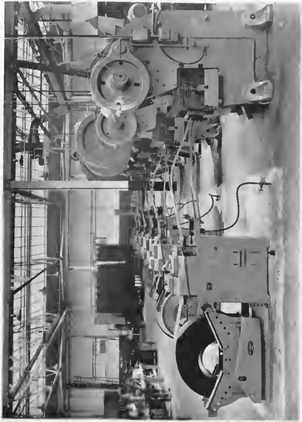


FIG. 39. Bow feeds.

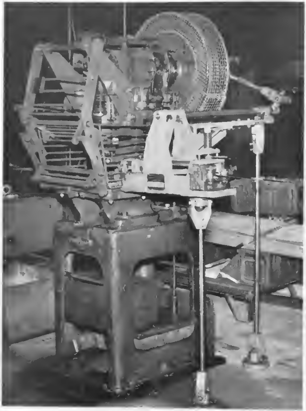


FIG. 40. Open fronted press fitted with gripper feed. The guard fitted to the press is dual purpose and suitable for use with the feed or for hand fed second operation work if required.

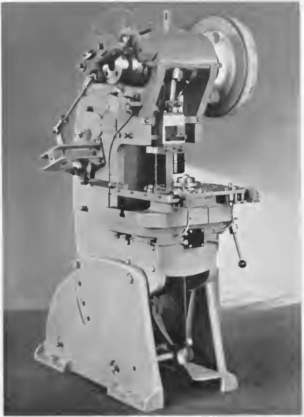


Fig. 41. Dial feed. Guard removed for purpose of photograph.

FIG. 42. Component feed with dial and mechanical transfer arm. Guard swung up for purpose of photograph.

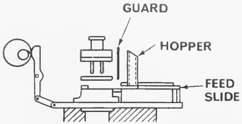


FIG. 43. Mechanically operated feed with hopper for components.

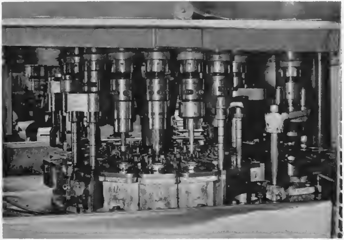


FIG. 44. Rotary transfer press tool assembly. (*Guard not shown.*)

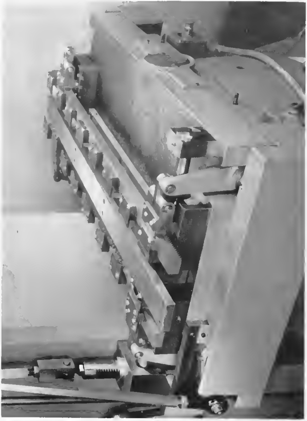


Fig. 45. A reciprocating transfer feed.

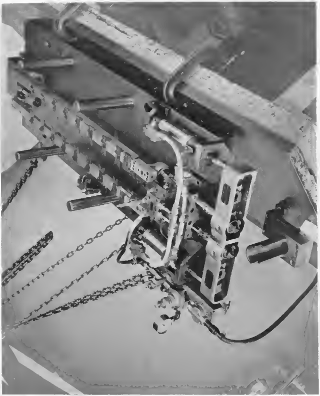


Fig. 46. Another example of a reciprocating transfer feed.

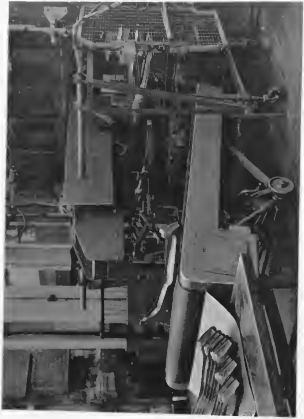


Fig. 47. General view of press with floor based unloader at rear.

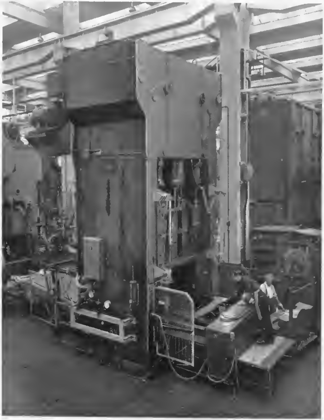


Fig. 48. Press fitted with loader at front end and unloader at rear.

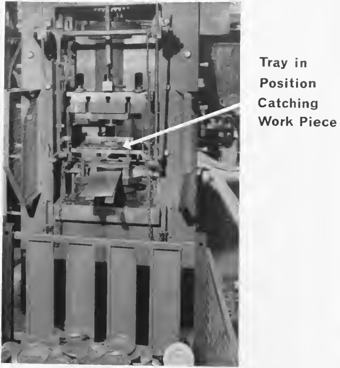


FIG. 49. Mechanically operated tray unloader for removing top ejected components from press.

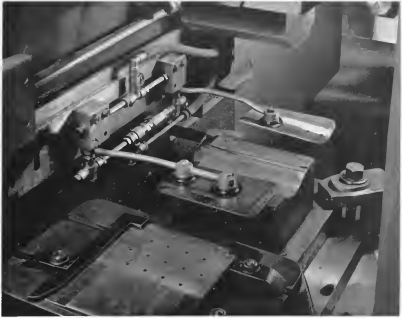


Fig. 50. Suction feed. Guard removed for purpose of photograph.

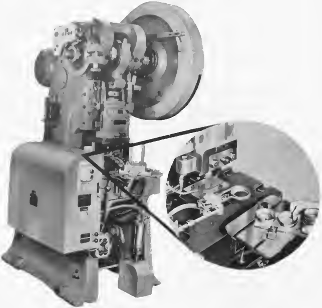


Fig 51. Mechanical press feeder with guard removed.